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## Comparison of Bone Marrow Aspiration Cytology, Touch Imprint Cytology and Bone Marrow Biopsy for Evaluation

<sup>1</sup>Dr. M. Santhoshi Jaha, Junior Resident, Department of Pathology, Viswa Bharathi Medical College, Kurnool, Andhra Pradesh, India

<sup>2</sup>Dr. Y. Sudha Sree, M.D., Department of Pathology, Viswa Bharathi Medical College, Kurnool, Andhra Pradesh, India

<sup>3</sup>Dr. Neeraja Myreddy, M.D., Department of Pathology, Viswa Bharathi Medical College, Kurnool, Andhra Pradesh, India

<sup>4</sup>Dr. C. Srilekha, M.D., Department of Pathology, Viswa Bharathi Medical College, Kurnool, Andhra Pradesh, India

**Corresponding Author:** Dr. M. Santhoshi Jaha, Junior Resident, Department of Pathology, Viswa Bharathi Medical College, Kurnool, Andhra Pradesh, India

**Conflict of interest:** Nil

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### Abstract

**Objectives:** The present study was conducted to compare the role of bone marrow aspirate, touch imprint and trephine biopsy.

**Methods:** A retrospective analysis was conducted in Department of Pathology, Viswa Bharathi Medical College, Kurnool Andhra Pradesh from January 2022 till December 2023

**Results:** out of 88 cases of Bone Marrow examination 71 cases were diagnosed on BMA with diagnostic accuracy of 80.6%, 73 cases diagnosed on BMI with diagnostic accuracy 83%, 83 cases diagnosed on BMB with diagnostic accuracy 94%.

**Conclusion:** All 3 preparations complement each other for BM Evaluation. Diagnostic accuracy of BMB was highest (94%) but diagnostic accuracy of BMI was also considerably high (83%) in comparison to BMA

(80.6%) . BMB remains the gold standard for diagnosing hypoplastic / aplastic anemia

**Keywords:** bone marrow aspiration cytology, bone marrow biopsy, touch imprint cytology, diagnostic accuracy.

### Introduction

Bone marrow examination is a useful investigative tool for diagnosis of many haematological & non haematological disorders. Bone marrow aspiration (BMA) provides information about the numerical and cytological features of marrow cells. Bone marrow imprint (BMI) also gives cytological picture but cells are less in number. Bone marrow trephine biopsies (BMB) provide excellent appreciation of spatial relationships between cells and of overall bone marrow structure

BMB is required in conditions such as inadequate or failed aspirate, assessment of cellularity and bone

marrow architecture, suspected focal lesion (for example, suspected granulomatous disease, or lymphoma) and bone marrow fibrosis. However, BMA has low sensitivity in detecting solid tumor metastasis and lymphoma involvement. The present study was conducted to compare the role of bone marrow aspirate, touch imprint and trephine biopsy and to formulate an effective and rapid method for diagnosing wide spectrum of hematological diseases .

### Materials & Methods

The present study was conducted in Department of Pathology, Viswa Bharathi Medical College, Kurnool , Andhra Pradesh from January 2022 till December 2023. The study included 88 cases in which bone marrow examination was done by using all the three methods of BMA , BMI and BMB.

The Aspirate sample is obtained using Salah's needle from posterior superior iliac spine. The trephine biopsy was done using Jamshidi / Salah's needle, fixed in EDTA 3 hours and for minimum of 24 hrs in 10% buffered formalin, decalcified overnight in mixture of 8% hydrochloric acid & 10% formic acid in equal amounts. Before fixation of biopsy minimum five touch imprint smears prepared using the procedure of gentle touch & rolling of biopsy core on the slide. Aspirate & touch imprint smears were routinely stained by Leishman's stain & Biopsy sections stained by H & E stain.



Figure 1: Salah needle for BMA



Figure 2: Jamshidi needle

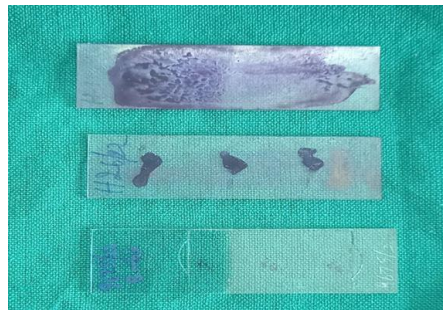


Figure 3: Stained Smears

### Results

Out of 88 cases of Bone Marrow examination 71 cases were diagnosed on BMA with diagnostic accuracy of 80.6%, 73 cases diagnosed on BMI with diagnostic accuracy 83%, 83 cases diagnosed on BMB with diagnostic accuracy 94%.

### Age & Sex distribution

In 88 cases, comparison was made between BMA , BMI and bone marrow biopsy (BMB) There were 50 (56.81%) males and 38 ( 43.18%) females with a

male to female ratio of 1.3 : 1. The age of the subjects ranged from 15 to 85 years. Majority of the cases were in fourth & fifth decade

Table 1:

Age (years)	Male	Female	Total ( % )
15- 25 yrs	07	03	10
25 – 35 yrs	08	09	17
35 – 45 yrs	06	08	14
45 – 55 yrs	10	11	21
55- 65 yrs	11	04	15
65 – 75 yrs	04	02	06
75 yrs & above	04	01	05
	50	38	88

**Clinical indications:** Pancytopenia and anemia were the most common clinical indications for performing a bone marrow examination. The other indications included were bleeding, hepatosplenomegaly, pyrexia of unknown origin, lymphadenopathy, etc.

Etiological distribution of cases in the study

Table 2:

Category	Causes	No of cases
Non malignant Haematological disorders ( 32.95 % )	Megaloblastic Anaemia	13 (14.86 %)
	Hypoplastic/Aplastic anaemia	07 ( 7.95 % )
	Iron Deficiency anaemia	05 ( 5.68 % )
	Immune thrombocytopenic Purpura	04 ( 4.54 % )
Malignant haematological disorders ( 69.04 % )	Acute Myeloid Leukemia	16 (18.18 %)
	Acute Lymphoblastic Leukemia	02 ( 2.27 % )
	Chronic Myeloid Leukemia	07 ( 7.95 % )
	Chronic Lymphocytic leukemia	04 ( 4.54 % )
	Plasmacytoma	09 (10.22%)
	Multiple myeloma	02 (2.27 %)
Lymphoma		05 ( 5.68 % )
	Myelofibrosis	03 ( 3.40% )
Metastasis to Bone marrow		03 ( 3.40% )
Hematological remission		08 ( 9.09 % )

The present study observed that the diagnostic accuracy of BMB was highest (94% ) but diagnostic accuracy of BMI ( 83 % ) was also high in comparison to BMA ( 80.6 % ) . Efficacy of BMI cytology observed in diagnosis of lymphomas, hematological malignancies , hematological remissions. 100 % of lymphoma cases were correctly diagnosed on BMI cytology in comparison to 60 % cases on

BMA. BMB was standard procedure which diagnosed all cases ( 100 % ) of metastatic bone tumors

For diagnosing of hematological malignancies BMA & BMI smears were near with detection rate of 86.20 % in BMI in comparison to 82.75 % in BMA . BMB remains gold standard for diagnosing hypoplastic/ aplastic anemia. It shows that 78 % cases showed positive correlation between BMA cytology and BMB sections while 81.81 % cases showed positive correlation between BMI cytology and BMB sections

Table 3:

	DIAGNOSIS	Total no of cases	BMA	BMI
1.	Megaloblastic Anaemia	13	13	12
2.	Hypoplastic / Aplastic Anaemia	07	04	06
3.	Iron Deficiency Anaemia	05	05	03
4.	Immune thrombocytopenic Purpura	04	04	04
5.	Hematological Malignancies	29	24	25
	Acute Myeloid Leukemia	16	12	14
	Acute Lymphoid Leukemia	02	02	02
	Chronic Myeloid Leukemia	07	07	07
	Chronic Lymphoid Leukemia	04	04	04
6.	Multiple Myeloma	02	02	02
7.	Lymphoma	05	03	05
8.	Myelodysplastic Disease	03	02	01
9.	Plasma cell Dyscrasias	09	06	08
10.	Metastatic solid tumors	03	02	01
11.	Hematological Remission	08	06	08
	Total	88	71	73
	Percentage		80.6%	83%

Accuracy of Diagnosis

Table 4:

Final Diagnosis (n)	Opinion on BMA (n)	Opinion on BMI (n)	Opinion on BMB (n)
1.Megaloblastic Anemia (13)	Megaloblastic erythroid hyperplasia (13)	Megaloblastic erythroid hyperplasia - (7) Normoblastic erythroid hyperplasia – (3) Dimorphic erythroid hyperplasia – (1) Normal marrow study –(1)	Megaloblastic erythroid hyperplasia - (7) Normoblastic erythroid hyperplasia – (3) Dimorphic erythroid hyperplasia – (1) Normal marrow study –(2)
2.Hypoplastic / Aplastic Anemia (7)	Hypoplastic / Aplastic Anemia (4)	Hypoplastic / Aplastic Anemia (6)	Hypoplastic / Aplastic Anemia (7)
3.Iron Deficiency Anemia (5)	Micronormoblastic erythroid hyperplasia (5)	Micronormoblastic erythroid hyperplasia (1)	Micronormoblastic erythroid hyperplasia (3) Normal Study (2)
4.Immune thrombocytopenic purpura (4)	Megakaryocytic Thrombocytopenia (3)	Megakaryocytic Thrombocytopenia (2)	Megakaryocytic Thrombocytopenia (4)
5. Plasmacytoma (9)	Plasmacytoma (6) Reactive plasmacytosis(3)	Plasmacytoma (9)	Plasmacytoma (9)

Final Diagnosis (n)	Opinion on BMA (n)	Opinion on BMI (n)	Opinion on BMB (n)
6.Hematological malignancies (29) AML (16) ALL (02) CML (7) CLL (04)	AML (12), AL (04) AL (02) CML (7) CLL (04)	AML (14) ALL (02) CML (7) CLL (04)	AML (16) ALL (02) CML (7) CLL (04)
7. Myeloproliferative Diseases (3)	Myeloproliferative neoplasm (2) Negative for MPD (1)	Myeloproliferative Diseases (1)	Myeloproliferative Diseases (3)
8.Lymphoma (5) NHL (3) HL(2)	BM infiltrates by NHL (2) BM Free from NHL (1) Marrow infiltrates by HL(1)	NHL (2) HL (2)	NHL (3) HL (2)
9.Multiple Myeloma (2)	Multiple Myeloma (2)	Multiple Myeloma (2)	Multiple Myeloma (2)
10.Metastatic bone tumors (3)	metastatic deposits (2)	metastatic deposits (1)	metastatic deposits (3)

Cases showing positive correlation of bone marrow aspirate cytology and imprint cytology with trephine biopsy

Table 5:

DIAGNOSIS	Positive correlation of BMA CYTOLOGY & BMB (% of cases )	Positive correlation of BMI CYTOLOGY & BMB (% of cases )
Megaloblastic Anaemia	100	92.3
Hypoplastic / aplastic Anemia	57.14	85.71
Iron Deficiency Anemia	100	60
Immune thrombocytopenic Purpura	75	75
Hematological malignancies	82.75	86.20
Plasmacytoma	66.66	100
Myelofibrosis	66.66	33.33
Metastatic bone tumors	66.66	100
Lymphoma	60	100
Multiple myeloma	100	100
Percentage %	78 %	81.81 %

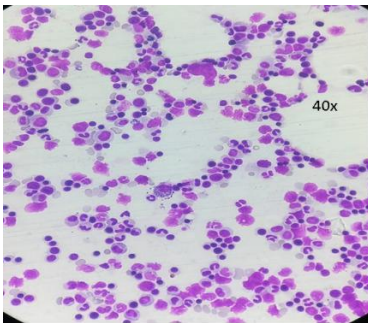


Figure 4: Erythroid hyperplasia with micronormoblast & megaloblastic changes

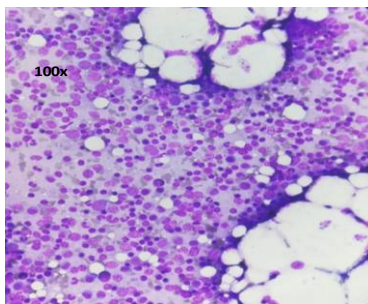


Figure 5: Iron deficiency Anemia

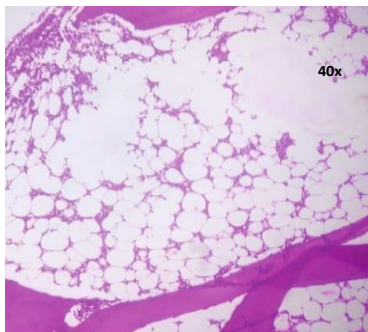


Figure 6: Aplastic Anemia

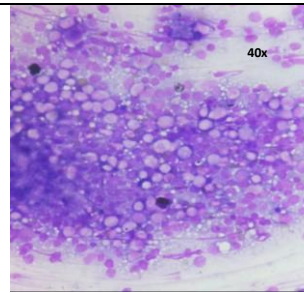


Figure 7: Megaloblastic Anemia

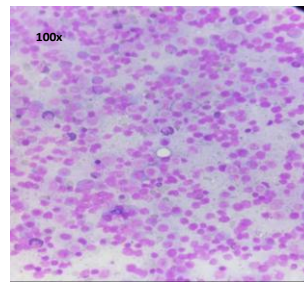


Figure 8: Megaloblastic Anemia

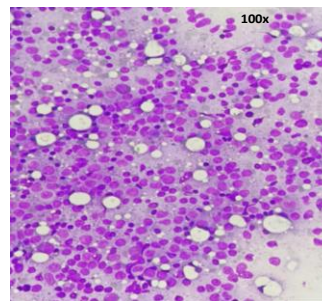


Figure 9: Acute Myeloid leukemia

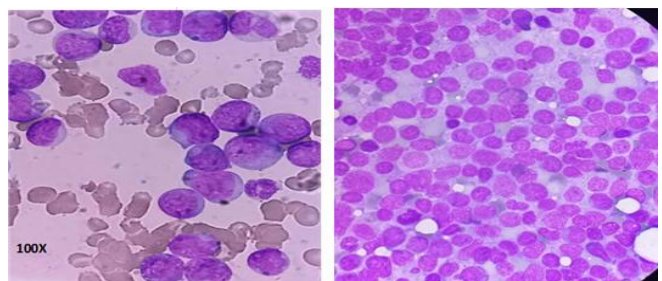


Figure: 10, 11: Acute Myeloid leukemia

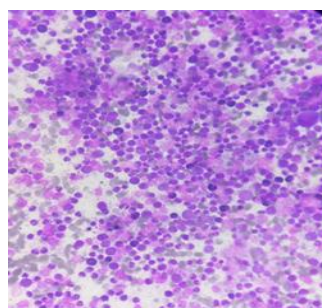


Figure12: Chronic Myeloid Leukemia

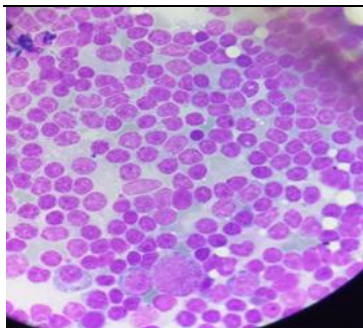


Figure13: Chronic Lymphocytic Leukemia

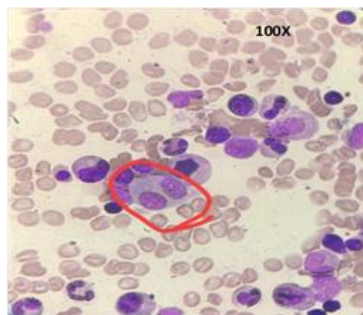


Figure 14: Hodgkins Lymphoma

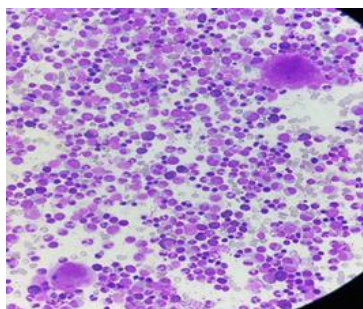


Figure15: Myeloproliferative neoplasm

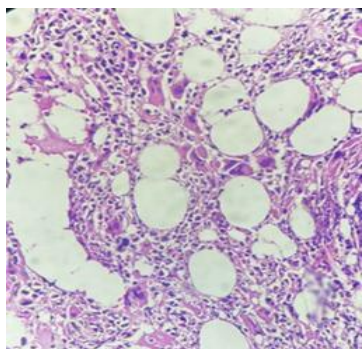


Figure 16: Myeloproliferative Diseases

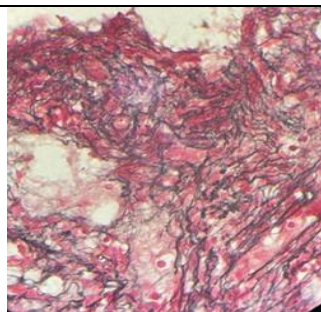


Figure 17: Reticulin stain

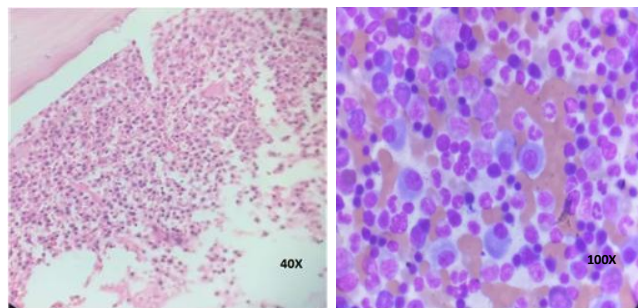


Figure 18 & 19: Plasmacytoma

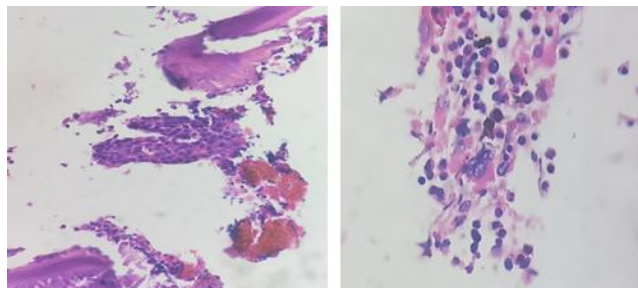


Figure 20 & 21: Metastatic deposit – poorly differentiated carcinoma

### Conclusion

All 3 preparations complement each other for BM Evaluation . Diagnostic accuracy of BMB was highest (94%) but diagnostic accuracy of BMI was also considerably high (83%) in comparison to BMA (80.6 %) . BMB remains the gold standard for diagnosing hypoplastic/ aplastic anemia. The adequacy of touch imprint smears in diagnosing most of the hematological disorders may be related to meticulously prepared imprint smears which requires not only gentle touch of the biopsy core on slides to prevent crush artifact but also preparation of touch

smears by gentle rolling the core so that impression of the cells are made by almost all aspects of the core biopsy. The topographical arrangement of lymphoma cells are best seen on biopsy sections but this arrangement can also be well appreciated in meticulously prepared touch imprint cytology smears. BMI cytology was reliable for making diagnosis of hemtological malignancies especially in cases of dry tap due to fibrosis or dilution of aspirate by peripheral blood.

BMI also avoids unnecessary delay caused by decalcification & processing of biopsy sections . Metastatic solid tumors were correctly diagnosed on BMI cytology than aspirate cytology . Imprint smears not only provide cellular composition of marrow but also helpful in defining the architecture of marrow.

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